

CONTRIBUTIONS
FROM THE
CUSHMAN LABORATORY
FOR
FORAMINIFERAL RESEARCH

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CONTENTS

	PAGE
No. 116. Some Interesting New Foraminifera from the Miocene of Florida.....	1
No. 117. Rectogümbelina, A New Genus from the Cretaceous.....	4
No. 118. Notes on the Genus Virgulina.....	7
Recent Literature on the Foraminifera	23

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These contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

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CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

116. SOME INTERESTING NEW FORAMINIFERA FROM THE MIOCENE OF FLORIDA

By JOSEPH A. CUSHMAN and GERALD M. PONTON

A paper soon to be published by the Florida State Geological Survey mainly on the Lower Miocene of Florida contains numerous new species and varieties. A few of these, representing two new genera, as well as one or two other things, are here published by permission of the State Geologist, Mr. Herman Gunter. The Lower Miocene of Florida, especially the Chipola marl, represents shallow warm water conditions which were very similar apparently to conditions now prevailing in the shallow water of the general West Indian and Floridian regions. The following forms are here described and figured.

Genus ANNULOCIBICIDES Cushman and Ponton, n. gen.

Genoholotype, *Annulocibicides projectus* Cushman and Ponton, n. sp.

Test attached by the dorsal side, the early stages close coiled and similar to *Cibicides*; later chambers becoming irregular, and those of the adult, annular; wall calcareous, distinctly perforate; apertures in the early stages similar to *Cibicides*, in the adult consisting of numerous short tubes at the periphery, opening at the outer end and sometimes with a slight lip.

This genus somewhat resembles *Cyclocibicides*, found in the present Mediterranean, but differs in the character of the wall which in the Recent form has very large rounded pores in the adult serving as apertures. These are not confined to the periphery as in this fossil form, but are scattered generally over the surface.

ANNULOCIBICIDES PROJECTUS Cushman and Ponton, n. sp.

Plate 1, figures 1 a, b

Test in the early stages slightly trochoid, the chambers in a single plane, attached, soon becoming broader and finally annular, periphery rounded, except for the tubular projections; chambers slightly inflated, fairly distinct from both sides; sutures distinct, slightly depressed, not limbate; wall opaque, rather granular in appearance, finely perforate; apertures in the adult at the peripheral margin of the test, large, oval or elliptical, with a distinct tubular neck. Diameter up to 1.00 mm.

Holotype (Cushman Coll. No. 16300) from the Chipola marl, type locality, McClelland's farm, on right (West) bank of Chipola River, about 3 miles East of the village of Carr, Calhoun County, Florida.

Genus RECTOCIBICIDES Cushman and Ponton, n. gen.

Genoholotype, *Rectocibicides miocenicus* Cushman and Ponton, n. sp.

Test attached, early chambers close coiled as in *Cibicides*, later chambers uncoiling, forming a rectilinear series, expanding somewhat as chambers are added; wall calcareous, rather coarsely perforate, especially on the outer side, the inner attached side with the wall thin and transparent; apertures in the early stages similar to *Cibicides*, in the adult, consisting of a series of tubular projections along the outer growing edge of the chamber, open at the outer end and sometimes with a slight lip.

This is a peculiar development derived directly from *Cibicides* by taking on an uncoiled rectilinear form. It shows no trace of becoming biserial as in *Dyocibicides*, but at once assumes the uniserial condition which is kept thereafter.

RECTOCIBICIDES MIOCENICUS Cushman and Ponton, n. sp.

Plate 1, figures 5-7

Test attached, compressed, the early stages close coiled, somewhat trochoid, later becoming uncoiled with the chambers in a rectilinear series, somewhat spread laterally, distinct; sutures distinct and depressed on the ventral side, distinct but not depressed, strongly limbate, on the attached dorsal side; wall coarsely perforate and cancellated on the ventral side, more finely perforate and fairly smooth on the attached dorsal side;

aperture on the dorsal side as in *Cibicides* in the early stages, in the rectilinear portion becoming large and tubular at the periphery. Diameter up to 1.30 mm.

Holotype (Cushman Coll. No. 16301) from the *Cancellaria* Zone of the Choctawhatchee marl, about a half mile up-stream from the type locality of the *Cancellaria* Zone on Harvey's Creek at Old Yankeetown, Leon County, Florida.

This species is very abundant at the type locality, and although it is an attached form and therefore somewhat variable, it keeps its characters rather well. In its aperture it somewhat resembles the preceding genus and species, but the method of growth is very distinct, and the two are rather widely apart in the Miocene section.

Genus CYCLOLOCULINA Heron-Allen and Earland, 1908

CYCLOLOCULINA MIOCENICA Cushman and Ponton, n. sp.

Plate 1, figures 3, 4

Test circular, very much compressed, periphery rounded, the two sides either flattened or even slightly concave toward the center; early chambers subglobular, rapidly increasing in breadth as added until annular chambers are formed, after which chambers of this sort are continued throughout the development; sutures fairly distinct, very slightly depressed; wall very coarsely perforated, and with numerous radial folds; apertures formed by the coarse perforations of the test. Diameter up to 1.00 mm.

Holotype (Cushman Coll. No. 16305) from the Chipola marl, a half mile below type locality on West bank of Chipola River at mouth of Senterfeit Branch, Florida.

This genus has previously been recorded from the Eocene of both Europe and America, but this species extends the record into the Miocene. It has a very short vertical range in the Miocene as it does in the Eocene, and wherever it occurs should form an excellent index fossil. It is interesting to speculate upon the occurrence of this form through the Oligocene, and it should be found in the general West Indian region in that formation.

Genus *VIRGULINA* d'Orbigny, 1826*VIRGULINA GUNTERI* Cushman, var. *CURTATA* Cushman and Ponton, n. var.

Plate 1, figure 2

Variety differing from the typical in the short rounded form and comparatively few chambers.

Holotype of variety (Cushman Coll. No. 16304) from Darling's Slide, about 2½ miles air line Southeast from Clarksville, Calhoun County, Florida.

This peculiar, short, rounded form takes the place of the typical in the *Ecphora* Zone of the Choctawhatchee, and at some of the stations becomes very abundant.

117. *RECTOGÜMBELINA*, A NEW GENUS FROM THE CRETACEOUS

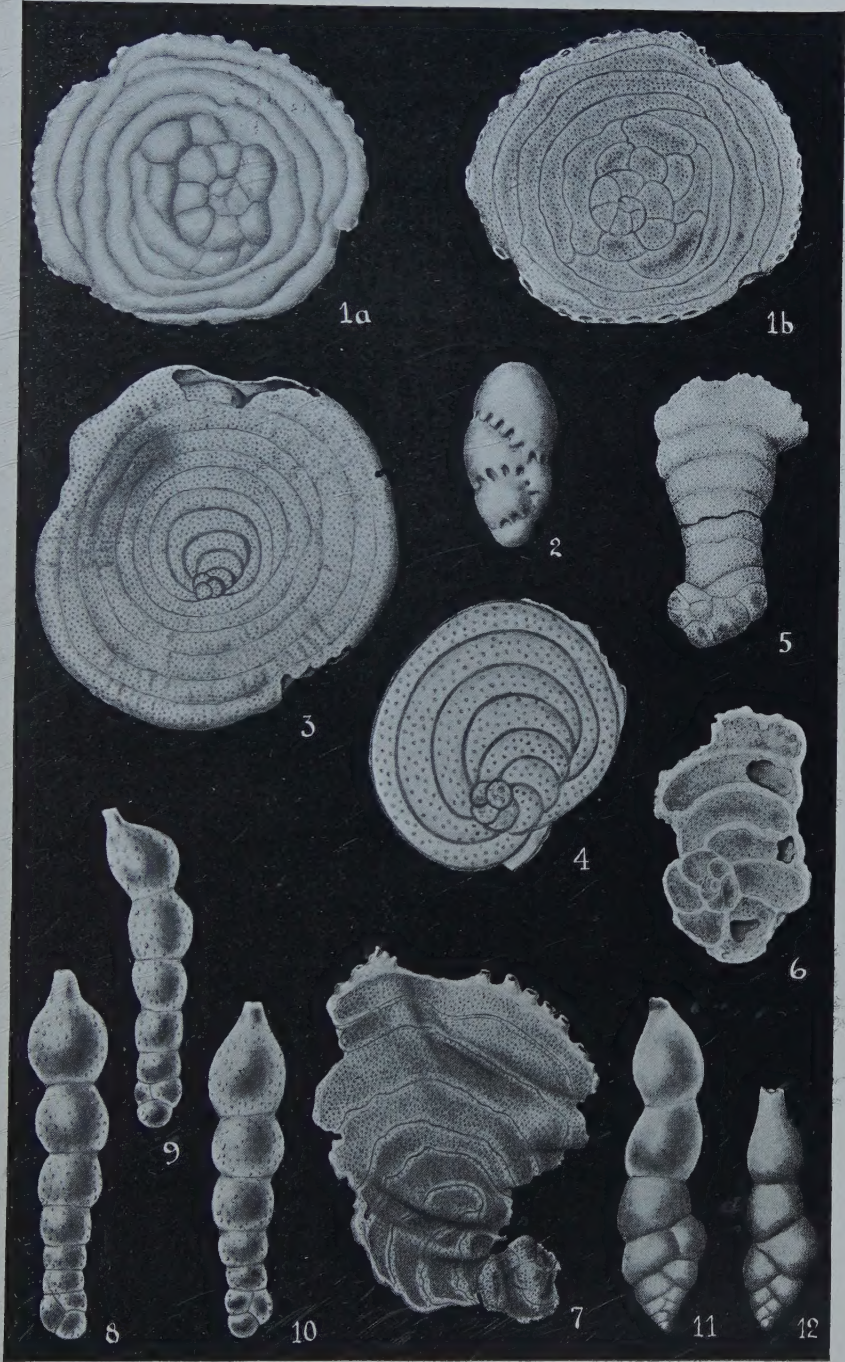
By JOSEPH A. CUSHMAN

In the Heteroheliciidae there are numerous developments which evidently came from *Gümbelina*, such as *Pseudotextularia*, *Planoglobulina*, *Ventilabrella*, etc. These have come about by the addition of more complex types of development. It is, there-

EXPLANATION OF PLATE 1

- FIGS. 1 *a, b.* *Annulocibicides projectus* Cushman and Ponton, n. sp. × 40. *a*, outer ventral side; *b*, inner attached dorsal side.
- FIG. 2. *Virgulina gunteri* Cushman, var. *curtata* Cushman and Ponton, n. var. × 55.
- FIGS. 3, 4. *Cycloloculina miocenica* Cushman and Ponton, n. sp. Fig. 3, × 55. Fig. 4, × 100. Fig 3, Holotype from exterior. Fig. 4, Early stages of another specimen mounted in Canada balsam.
- FIGS. 5-7. *Rectocibicides miocenicus* Cushman and Ponton, n. sp. × 32. Fig. 5, Holotype from the outer side. Fig. 6, Paratype, early stage showing the attached dorsal side. Fig. 7, A somewhat irregular adult form showing the tubular apertures.
- FIGS. 8-10. *Rectogümbelina texana* Cushman, n. sp. × 160. Fig. 8, Holotype. Figs. 9, 10, Paratypes.
- FIGS. 11, 12. *Rectogümbelina cretacea* Cushman, n. sp. × 145. Fig. 11, Holotype. Fig. 12, Paratype.

Figures drawn by Margaret S. Moore.



fore, interesting to note the following genus which is in its general characters a parallelism with *Bigenerina* in the Textulariidae. Our species, however, are developed directly from *Gümbelina* as the early stages show, and the wall is calcareous and finely perforate. It is to be looked for, from the two records given here, in the various portions of the Upper Cretaceous of Texas and adjacent regions.

Genus RECTOGÜMBELINA Cushman, n. gen.

Genoholotype, *Rectogümbelina cretacea* Cushman, n. sp.

Test with the early chambers arranged in a biserial manner similar to *Gümbelina*, later chambers uniserial and rounded in transverse section; chambers all inflated, distinct; sutures distinct, depressed; wall calcareous, thin, very finely perforate; aperture in the early stages similar to *Gümbelina*, in the adult terminal, rounded, with a distinct neck.

The two species described below represent our present knowledge of this genus, but more species are to be looked for.

RECTOGÜMBELINA CRETACEA Cushman, n. sp.

Plate 1, figures 11, 12

Test consisting of two unequal portions, the early portion consisting of several pairs of globular chambers arranged as in *Gümbelina*, the adult stage uniserial, formed usually by three subglobular or slightly pyriform chambers, slightly overlapping, the apertural end extended out into a tapering neck; sutures distinct, depressed; wall smooth, translucent, very finely perforate; aperture circular, at the end of the tubular neck. Length 0.25-0.35 mm.; breadth 0.08-0.10 mm.; thickness 0.05-0.07 mm.

Holotype (Cushman Coll. No. 16308) from the Arkadelphia Clay on the Hope-Prescott (Little Rock) road, 5½ miles Northeast of Hope, Arkansas, in Southwest corner, N. W. ¼, Sec. 6, T. 12 S., R. 23 W., collected by L. W. Stephenson.

This is a somewhat larger species than the following, holds the *Gümbelina* stage much longer, and has distinctly fewer chambers in the uniserial portion.

RECTOGÜMBELINA TEXANA Cushman, n. sp.

Plate 1, figures 8-10

Test elongate, tapering, the early three or four chambers more or less globular and arranged in a biserial manner but similar

to *Gümbelina*, the large portion of the test made up of globular or pyriform chambers, uniserially arranged in a straight line; chambers distinct, slightly overlapping, apertural end drawn out into a definite tapering neck; sutures distinct, depressed; wall very thin, calcareous, finely perforate, but the surface ornamented by slight spinose projections giving it a rough appearance; aperture rounded, at the end of the tubular neck. Length 0.25-0.30 mm.; diameter 0.06-0.07 mm.

Holotype (Cushman Coll. No. 16306) from the Argillaceous Chalk, Middle Austin in age, from East bank of small stream at South end of Bridge on Van Alstyne—Gunter road, 2.3 miles West of Van Alstyne, Grayson County, Texas, collected by C. I. Alexander.

This species differs from the preceding in the rough wall, smaller form, greatly reduced early stage, and the consequent greater development of the uniserial portion.

118. NOTES ON THE GENUS VIRGULINA

By JOSEPH A. CUSHMAN

Outlines are here given of the type figures of the various species which have been referred to *Virgulina* with the exception of a few which evidently do not belong in the genus. It is somewhat difficult to give the exact arrangement of the sutures in such outline drawings, as these are often obscured by the shading of the early portions of the test in the originals. Occasionally the sutures are evidently incorrectly drawn, but the main object of these notes is to make copies of the original figures available for those workers who do not have access to them. Notes are likewise given as well as brief descriptions under several of the species. The species are grouped by geologic periods to show the age and locality for the types.

Any considerable study of the literature will at once show that a few names have been used to cover a great diversity of things. For example, the references to *Virgulina schreibersiana* Czjzek make up about one-third of all the references to this genus. The various figures referred to this species show that

several different things have been referred to this species in recording it from Eocene to Recent. The majority of the references are without figures, and it, therefore, becomes impossible to decide what these forms may be without a study of original material.

The name "*Virgulina subsquamosa* Egger" is next in its number of records, and it too covers a wide range of forms from a wide geographical area and long geologic range. Other species have not been referred to since their original descriptions and figures were given.

From my own experience with the various living and fossil species, there are very definite characters which are held with reasonable uniformity, and the geologic range is not as great for a species as is often indicated by the records.

Genus VIRGULINA d'Orbigny, 1826

Genoholotype, *Virgulina squamosa* d'Orbigny

Virgulina D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 267.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 413.—CHAPMAN, The Foraminifera, 1902, p. 172.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 91; Bull. 104, pt. 3, 1922, p. 114; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 248.

Strophoconus EHRENBURG, Bericht. k. preuss. Akad. Wiss. Berlin, 1843, p. 166 (genotype, by designation, *Strophoconus auricula* EHRENBURG).

Grammobotrys EHRENBURG, l. c., 1845, p. 368 (genoholotype, *Grammobotrys africana* EHRENBURG).

Bulimina (part) of authors.

Polymorphina (part) of authors.

Test elongate, more or less compressed, fusiform, the early chambers spiral about the elongate axis, triserial, later ones becoming irregularly biserial, whole test usually twisted; wall calcareous, finely perforate; aperture elongate, loop-shaped, usually with an apertural tooth or plate and internal spiral tube.

Lower Cretaceous to Recent.

The earliest records for this genus are from the Lower Cretaceous, and its development continues to the present time. There are a very few species characteristic of warm shallow waters, but as a whole the representatives of the genus are apparently most at home in waters of medium depth on the slopes of the continental shelf where specimens are often very numerous.

The genus evidently developed from *Bulimina*, and the early stages of most species, especially in the microspheric form, are definitely in a triserial spiral. The later chambers differ much in various species, but usually take on a twisted biserial form.

In the Miocene of Europe and eastern America there is a group of species which have very peculiar characters of the sutures. There are long finger-like processes extending back from the border of the chamber into the preceding one, leaving a series of pits. These pits and extensions are very similar in external appearance to the retral processes in the genus *Elphidium*. Sections of the test of these virguline forms do not give evidence that these are anything but external ornamentation, while in *Elphidium* they have a definite relationship to the internal canal system. These Miocene forms are so very distinctive that the following subgenus is prepared for them.

Subgenus VIRGULINELLA Cushman, new subgenus

Subgenoholotype, *Virgulina pertusa* REUSS, Sitz. Akad. Wiss. Wien, vol. 42, 1860 (1861), p. 362, pl. 2, figs. 16 a, b.

Test similar to that of typical *Virgulina*, but with the sutures marked by finger-like processes extending backward onto the surface of the preceding chamber and the intermediate spaces between the processes deeply excavated.

As far as known, the species are limited to the Miocene, but notes under the species are given.

SPECIES WITH TYPES FROM THE PRESENT OCEANS

VIRGULINA PUNCTATA d'Orbigny (Pl. 2, figs. 1 a, b)

Virgulina punctata D'ORBIGNY, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 139, pl. 1, figs. 35, 36.—CUSHMAN, Publ. 291, Carnegie Instit. Washington, 1919, p. 35; Publ. 311, 1922, p. 31, pl. 3, fig. 9; Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 117; Publ. 344, Carnegie Instit. Washington, 1926, p. 77; Bull. 4, Fla. State Geol. Survey, 1930, p. 44, pl. 8, figs. 7 a, b.—CUSHMAN and PARKER, Proc. U. S. Nat. Mus., vol. 80, Art. 3, 1931, p. 15.—COLE, Bull. 6, Fla. State Geol. Survey, 1931, p. 40, pl. 6, fig. 14.

Virgulina squamosa CUSHMAN (not D'ORBIGNY), Publ. 213, Carnegie Instit. Washington, 1918, p. 284.

Test elongate, fusiform, broadest near the middle, initial end bluntly pointed; chambers numerous, earliest triserial, later irregularly biserial, inflated; sutures slightly depressed; wall finely perforate.

A common Recent species from Florida and the West Indies southward to the Falklands, and fossil in the Pliocene and Miocene. The test is often broader than the type figure shows. It is one of the few species abundant in shallow warm waters.

VIRGULINA COMPRESSA (Bailey) (Pl. 2, figs. 2 a, b)

Bulimina compressa BAILEY, Smithsonian Contr., vol. 2, Art. 3, 1851, p. 12, pl. 12, figs. 35-37.

Bulimina presli REUSS, var. (*Virgulina*) *schreibersii* (part) PARKER and JONES, Philos. Trans., vol. 155, 1865, p. 375, pl. 17, fig. 72.

Virgulina schreibersiana FLINT (not CZJZEK), Rep't U. S. Nat. Mus., 1897 (1899), p. 291, pl. 37, fig. 6.

Virgulina compressa CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 116, pl. 24, figs. 2, 3.

This is a much larger, thicker walled species than the preceding. The test is very white with a polished surface. It is characteristic of the continental shelf region of the eastern coast of North America, 53-1594 fathoms.

VIRGULINA PAUCILOCULATA H. B. Brady (Pl. 2, figs. 3 a-c)

Virgulina pauciloculata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 414, pl. 52, figs. 4, 5.—EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 292, pl. 8, figs. 86-88, 94.—PEARCEY, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1015.—CUSHMAN, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 168; Bull. 104, pt. 3, 1922, p. 212.—HERON-ALLEN and EARLAND, British Antarctic Exped., Zoology, vol. 6, 1922, p. 132.

"Test elongate, oval or subcylindrical, somewhat compressed, tapering slightly, ends rounded, aboral extremity mucronate. Segments few in number, long, erect, but little inflated, irregularly arranged. Aperture a curved loop, situated on the inner face of the final chamber. Length, 1/60th inch (0.42 mm.)."

This rather peculiarly formed species is recorded from widely separated localities in the present oceans. The types are from off New Guinea. Egger's figures do not all seem to be this species. Liebus records the species from Lower Miocene of Bavaria (Jahrb. geol. Reichsanst., vol. 52, 1903, p. 81, pl. 5, fig. 4), but his figures seem to show that his species is different from Brady's.

VIRGULINA SUBDEPRESSA H. B. Brady (Pl. 2, figs. 4 a, b)

Virgulina subdepressa H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 416, pl. 52, figs. 14-17.—CHAPMAN, Proc. Zool. Soc. London, 1895, p. 23.—GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 47.—CHAP-

MAN, Journ. Linn. Soc. Zool., vol. 30, 1907, p. 31, pl. 4, fig. 78; 1910, p. 403.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 93, fig. 147 (in text); Bull. 100, vol. 4, 1921, p. 170; pt. 3, 1922, p. 119.—HERON-ALLEN and EARLAND, British Antarctic Exped., Zoology, vol. 6, 1922, p. 131.

"Test elongate, subcylindrical, more or less compressed; oral end obtuse, rounded or subangular; aboral extremity broad and rounded; margin crenulate. Segments numerous, triangular in lateral aspect, slightly inflated; arranged in two inaequilateral alternating series. Aperture an oblique or nearly erect loop-like slit, on the inner face of the final chamber. Length, $1/25$ th inch (1.00 mm.)."

Most of the records for this species are from the Pacific, but there are a few from the Atlantic. Chapman records it from the Tertiary of Australia.

VIRGULINA TEXTURATA H. B. Brady (Pl. 2, figs. 5 a, b)

Virgulina texturata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 415, pl. 52, figs. 6 a, b.—EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 292, pl. 8, fig. 99.—CHAPMAN, Journ. Linn. Soc. Zool., vol. 30, 1910, p. 403.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 95, fig. 149 (in text); Bull. 104, pt. 3, 1922, p. 119.

"Test elongate, somewhat compressed, broadest near the oral end and tapering to a point at the aboral extremity; oral end obtuse or rounded; margin lobulated. Segments numerous, ventricose, arranged in two, inaequilateral, regularly alternating series. Aperture a nearly erect loop-like slit on the inner face of the final segment. Length, $1/20$ th inch (1.30 mm.)."

Nearly all the records for this species are from the South Pacific in fairly deep water, but a few in the North Pacific and South Atlantic.

VIRGULINA SCHREIBERSIANA Czjzek, var. COMPLANATA Egger (Pl. 2, figs. 6 a, b)

Virgulina schreibersiana CZJZEK, var. *complanata* EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 292, pl. 8, figs. 91, 92.

This is a peculiar form known only from the type locality off West Australia in 90-359 meters.

VIRGULINA OBSCURA Goës (Pl. 2, figs. 7 a, b)

Virgulina obscura GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 48, pl. 9, figs. 457, 458.—KIAER, Rep't Norwegian Fish. and Mar. Invest., vol. 1, No. 7, 1900, p. 34.—CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 121.

This is like its name a very obscure species from the small figure given by Goës and the fact that he places *Virgulina texturata* H. B. Brady as a synonym of it though Brady's species was published ten years earlier. It may be found to be a definite species in the cold waters of northern Europe from which it was recorded.

VIRGULINA SUBSQUAMOSA Egger, var. STRIATA Bagg (Pl. 2, fig. 8)

Virgulina squamosa striata BAGG, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 137, pl. 5, fig. 7.

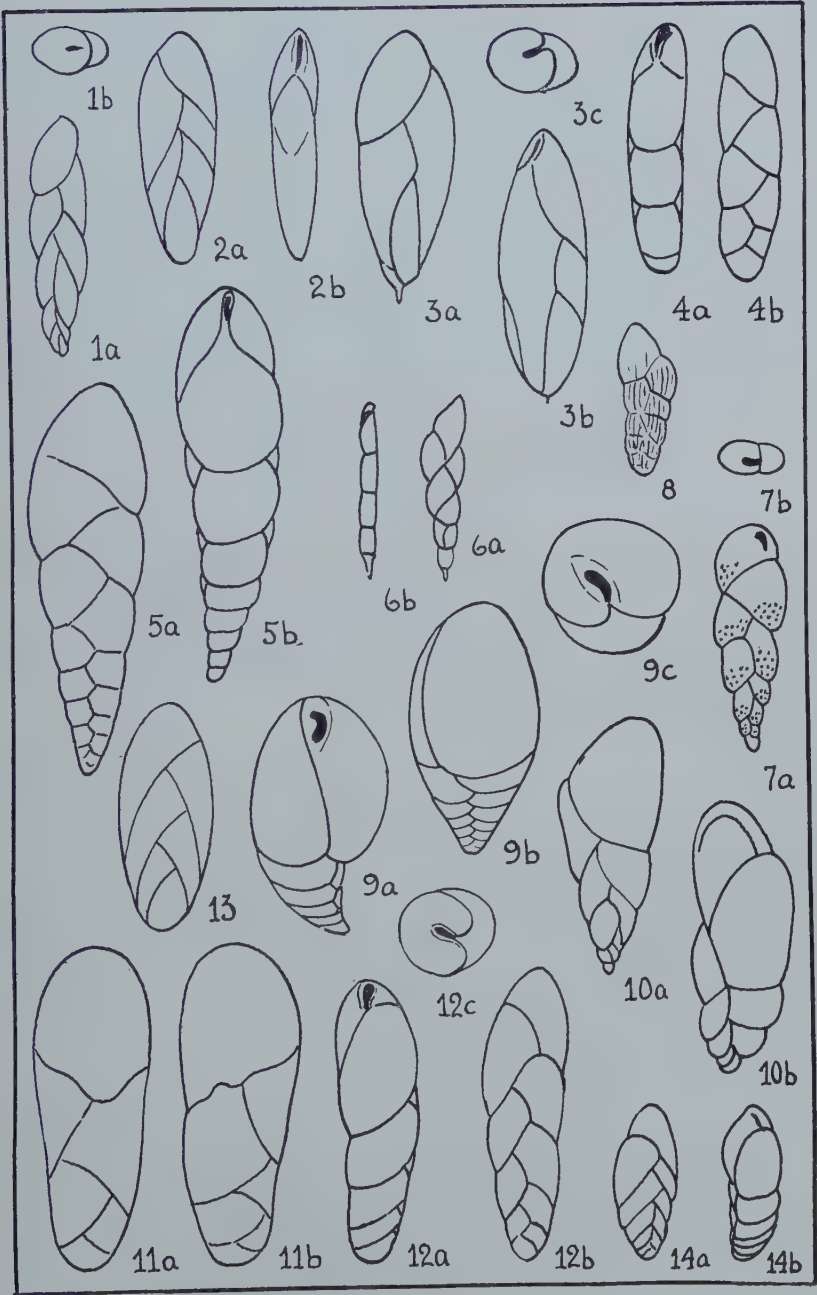
Virgulina subsquamosa EGGER, var. *striata* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 93.

Test elongate, slightly tapering, bluntly rounded at the apical end, obliquely truncate at the apertural end; chambers about as broad as high, somewhat inflated; sutures distinct, very little depressed; wall with longitudinal costae.

This form was described from off the Hawaiian Ids. in 275-368 fathoms. It may be a distinct species.

EXPLANATION OF PLATE 2

- FIGS. 1 *a, b.* *Virgulina punctata* d'Orbigny. *a*, side view; *b*, apertural view.
- FIGS. 2 *a, b.* *Virgulina compressa* (Bailey). *a*, side view; *b*, peripheral view.
- FIGS. 3 *a-c.* *Virgulina pauciloculata* H. B. Brady. *a, b*, opposite sides; *c*, apertural view.
- FIGS. 4 *a, b.* *Virgulina subdepressa* H. B. Brady. *a*, peripheral view; *b*, side view.
- FIGS. 5 *a, b.* *Virgulina texturata* H. B. Brady. *a*, side view; *b*, peripheral view.
- FIGS. 6 *a, b.* *Virgulina schreibersiana* Czjzek, var. *complanata* Egger. *a*, side view; *b*, peripheral view.
- FIGS. 7 *a, b.* *Virgulina obscura* Goës. *a*, side view; *b*, apertural view.
- FIG. 8. *Virgulina subsquamosa* Egger, var. *striata* Bagg.
- FIGS. 9 *a-c.* *Virgulina cornuta* Cushman. *a, b*, opposite sides; *c*, apertural view.
- FIGS. 10 *a, b.* *Virgulina carinata* Heron-Allen and Earland. *a, b*, opposite sides.
- FIGS. 11 *a, b.* *Virgulina* (?) *advena* Cushman. *a, b*, opposite sides.
- FIGS. 12 *a-c.* *Virgulina bradyi* Cushman. *a*, peripheral view; *b*, side view; *c*, apertural view.
- FIG. 13. *Virgulina mexicana* Cushman.
- FIGS. 14 *a, b.* *Virgulina tenuis* Seguenza. *a*, side view; *b*, peripheral view.



VIRGULINA CORNUTA Cushman (Pl. 2, figs. 9 a-c)

Virgulina cornuta CUSHMAN, Proc. U. S. Nat. Mus., vol. 44, 1913, p. 637, pl. 80, fig. 1; Bull. 100, vol. 4, 1921, p. 170, pl. 32, figs. 3-6; Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, No. 10, 1927, p. 154, pl. 3, fig. 2.—CUSHMAN and MOYER, Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 57, pl. 8, fig. 1.

Test pointed at the initial end, broadly rounded at the apertural end, whole test curved, somewhat spiral, irregularly biserial, last-formed chambers very tumid; wall thin, translucent, smooth; aperture a comma-shaped opening with a slightly raised lip. Length 0.50 mm.

This much inflated species is apparently confined to the Pacific, but known from both the Philippine region and from the West coast of America.

VIRGULINA CARINATA Heron-Allen and Earland (Pl. 2, figs. 10 a, b)

Virgulina schreibersiana CZJZEK, var. *carinata* HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, 1915, p. 643, pl. 49, figs. 13-17.

This form described from the Kerimba Archipelago off South-east Africa seems worthy of specific rank. It has distinct keels in well developed specimens, and a very large aperture.

VIRGULINA (?) ADVENA Cushman (Pl. 2, figs. 11 a, b)

Virgulina (?) advena CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 120, pl. 25, figs. 1-3.

This form described from the western Atlantic from deep water has a nearly terminal aperture with few and rounded chambers.

VIRGULINA BRADYI Cushman (Pl. 2, figs. 12 a-c)

Virgulina subsquamosa H. B. BRADY (part) (not EGGER), Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 415, pl. 52, figs. 9 a-c [7, 8?].

Virgulina bradyi CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 115, pl. 24, fig. 1.

Test elongate, very slightly compressed, fusiform or somewhat tapering, initial end bluntly rounded, apertural end rounded; chambers biserially arranged, but somewhat twisted on the axis, comparatively few in number, inflated; sutures distinct, depressed; wall smooth; aperture elongate, oval, the inner end broadest, with a slight rim; color white. Length 0.70-0.80 mm.

The types are from the deep water of the western Atlantic off Nantucket.

VIRGULINA MEXICANA Cushman (Pl. 2, fig. 13)

Virgulina mexicana CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 120, pl. 23, fig. 8.

Test elongate, compressed, broadly fusiform, broadly rounded at the initial end, apertural end bluntly pointed; chambers few, rounded, not well distinguished from one another; sutures indistinct, not depressed; wall smooth and polished, translucent; aperture elongate, oval, broadest at its inner end, thence narrowing toward the edge of the chamber; color white. Length 0.40-0.50 mm.

The types of this broad, somewhat compressed form are from the Gulf of Mexico in 347 fathoms.

SPECIES WITH TYPES FROM THE PLEISTOCENE

VIRGULINA TENUIS Seguenza (Pl. 2, figs. 14 a, b)

Virgulina tenuis SEGUENZA, Atti Accad. Gioenia Sci. Nat., ser. 2, vol. 18, 1862, p. 28, pl. 2, figs. 2, 2 a.

The only record for this is the original from the Pleistocene of Catania, Sicily.

SPECIES WITH TYPES FROM THE PLIOCENE

VIRGULINA SQUAMMOSA d'Orbigny (Pl. 3, figs. 1 a-c)

Virgulina squamosa D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 267, No. 1; Modèles No. 64.—MACFADYEN, Geol. Survey Egypt, 1930 (1931), p. 56, pl. 1, figs. 23 a, b.

No original figure was given, and the species must rest upon the Model No. 64 of d'Orbigny. I have one of the original d'Orbigny models before me, and have made the outline figure from this. Most of the references to this by most authors are not the same although that of Macfadyen from the Miocene of Europe is evidently this species.

The types are from the Pliocene of the Siena region of Italy, probably from Coroncina. I collected material from Coroncina in 1927, and it contains two forms, one rather rare and much like d'Orbigny's figure, and the other much more common and like Czjzek's *V. schreibersiana* from the Miocene of the Vienna

Basin. The typical form of *V. squamosa* then is slightly compressed and irregularly biserial except for the earliest portion which is distinctly triserial in the Coroncina specimens. As many of the Pliocene species of Italy are now living, it may be safely said that the range is probably from Miocene to Recent in the Mediterranean area. The other records for the species all need reviewing, although some of them are obviously misidentified.

VIRGULINA SCHREIBERSIANA Czjzek, var. **OBESA** Jones (Pl. 3, fig. 2)

Virgulina schreibersiana CZJZEK, var. *obesa* JONES, Foram. Crag., pt. 2, 1895, p. 166, pl. 6, fig. 20.

This variety is only known from the Pliocene, Coralline Crag of Sudbourne Hall, England.

VIRGULINA NODOSA R. E. and K. C. Stewart (Pl. 3, figs. 3 a-c)

Virgulina nodosa R. E. and K. C. STEWART, Journ. Pal., vol. 4, 1930, p. 64, pl. 8, figs. 4 a-c; Bull. Amer. Assoc. Petr. Geol., vol. 14, 1930, p. 1448.

Test about three times as long as broad, greatest width near the apertural end which is broadly rounded in apertural view and sharply rounded in side view, tapering to a bluntly pointed initial end; chambers numerous, distinct, inflated, the early ones triserially spiral about an elongate axis, later ones more or less irregularly biserial, the last three making up half or slightly more than half of the test; sutures distinct, considerably depressed; wall smooth but distinctly perforate; aperture a comma-shaped opening in a depression of the inner face of the last-formed chamber. Length up to 0.35 mm.; breadth 0.13 mm.; thickness 0.11 mm.

This distinctive species is known only from the Lower Pliocene of California.

SPECIES WITH TYPES FROM THE MIOCENE

VIRGULINA ACUTA (d'Orbigny) (Pl. 3, fig. 4)

Polymorphina acuta D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 265, No. 7; Foram. Foss. Bass. Tert. Vienne, 1846, p. 234, pl. 13, figs. 4, 5; pl. 14, figs. 5-7.

In his study of d'Orbigny's types, Dr. Ozawa found this species to be a *Virgulina*. It is close to *V. squamosa* d'Orbigny, but the figures show the chambers as more regular.

VIRGULINA SCHREIBERSIANA Czjzek (Pl. 3, figs. 5 a-c)

Virgulina schreibersiana CZJZEK, Haidinger's Nat. Abhandl., vol. 2, 1848, p. 11, pl. 13, figs. 18-21.—REUSS, Sitz. Akad. Wiss. Wien, vol. 55, pt. 1, 1867, p. 96, pl. 4, figs. 4, 5.—TERRIGI, Atti Accad. Pont. Nuovi Lincei, vol. 33, 1880, p. 74, pl. 2, figs. 38, 39.—FORNASINI, Rend. Accad. Sci. Bologna, vol. 2, 1897-1898 (1898), p. 18, pl. 2, fig. 9; Mem. Accad. Sci. Istit. Bologna, ser. 5, vol. 8, 1900, p. 21 (111), fig. 24 (in text); l. c., ser. 5, vol. 9, 1901, p. 11, pl. 0, figs. 28, 44.—SILVESTRI, Atti Pont. Accad. Nuovi Lincei, vol. 57, 1903, p. 22, text figs. 1 a-c (not 2 a-d = *V. squamosa* D'ORBIGNY).—SIDEBOTTOM, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 13, pl. 3, fig. 4.—MACFADYEN, Geol. Survey Egypt, 1930 (1931), p. 56, pl. 1, figs. 24 a, b.

This species has been recorded more than any other of the genus. As noted above, many of these records are obviously not this species, and many others are without figures. Brady's *Challenger* figures are not typical, and he has been followed by many later authors. The species is a very characteristic one from Recent to Oligocene in the Mediterranean region and southern Europe. Its range elsewhere must be proved with better evidence than is to be had at present.

The early chambers are strongly triserial and elongate, only the last 4-6 usually being irregularly biserial. The above references give figures which are typical of this species. The types are from the Miocene of the Vienna Basin.

VIRGULINA SUBSQUAMOSA Egger (Pl. 3, figs. 6 a-c)

Virgulina subsquamosa EGGER, Neues Jahrb. für Min., Jahrg. 1857, p. 295, pl. 12, figs. 19-21.

While there are many records for this species, those with figures for the most part do not seem to be typical. This may be due to the fact that Brady's *Challenger* figures represent at least three different species. The typical form has many short, strongly inflated chambers with a decided twist to the whole test. The types are from the Miocene of Bavaria.

Survey Egypt, 1930 (1931), p. 56, pl. 1, figs. 24 a, b.

VIRGULINA PONTONI Cushman, n. sp. (Pl. 3, fig. 7)

Virgulina floridana CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 109, pl. 12, figs. 3 a, b (not *V. floridana* CUSHMAN, 1920).

Test elongate, tapering, greatest breadth formed by the last two chambers, periphery rounded; chambers distinct, slightly inflated, earlier ones decidedly triserial, later ones biserial but

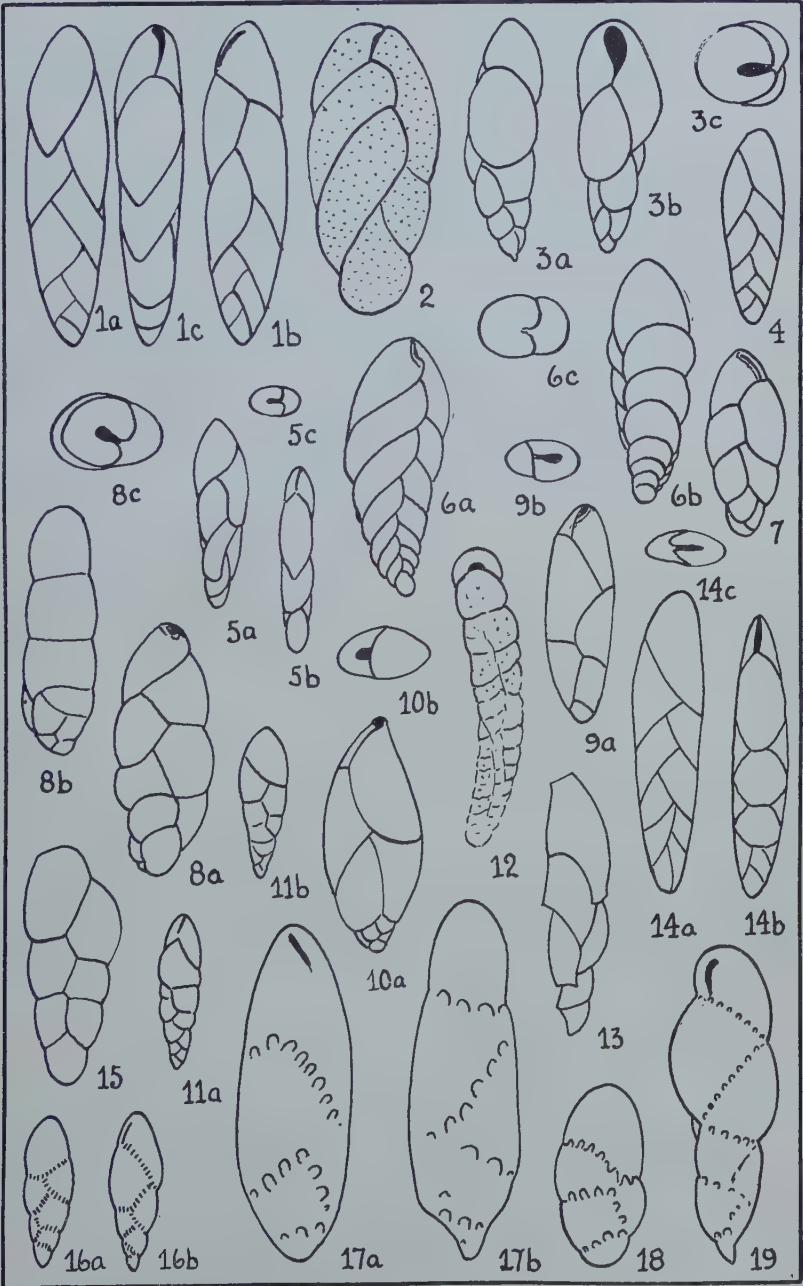
somewhat twisted; sutures distinct, slightly depressed; wall smooth, finely perforate; aperture elongate, narrow. Length up to 0.90 mm.; breadth 0.28 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 16298) from Miocene (Oak Grove sand) of Tanners Mill (Old Senterfeit Mill), 4 miles S. W. of Laurel Hill, Okaloosa County, Florida.

A re-examination of the type of *Virgulina floridana* published in 1920 shows that it is a very loosely coiled form of *Buliminella elegantissima* (d'Orbigny). A new name must therefore be proposed for this. This species is widely distributed in the Miocene of both Florida and California.

EXPLANATION OF PLATE 3

- FIGS. 1 *a-c.* *Virgulina squamosa* d'Orbigny. *a*, *b*, opposite sides; *c*, peripheral view.
- FIG. 2. *Virgulina schreibersiana* Czjzek, var. *obesa* Jones.
- FIGS. 3 *a-c.* *Virgulina nodosa* R. E. and K. C. Stewart. *a*, peripheral view; *b*, side view; *c*, apertural view.
- FIG. 4. *Virgulina acuta* (d'Orbigny).
- FIGS. 5 *a-c.* *Virgulina schreibersiana* Czjzek. *a*, side view; *b*, peripheral view; *c*, apertural view.
- FIGS. 6 *a-c.* *Virgulina subsquamosa* Egger. *a*, side view; *b*, peripheral view; *c*, apertural view.
- FIG. 7. *Virgulina pontoni* Cushman, n. sp.
- FIGS. 8 *a-c.* *Virgulina californiensis* Cushman. *a*, side view; *b*, peripheral view; *c*, apertural view.
- FIGS. 9 *a, b.* *Virgulina bramletti* Galloway and Morrey. *a*, side view; *b*, apertural view.
- FIGS. 10 *a, b.* *Virgulina fusiformis* Cushman. *a*, side view; *b*, apertural view.
- FIGS. 11 *a, b.* *Virgulina mustoni* Andreae. *a*, *b*, opposite sides.
- FIG. 12. *Virgulina digitalis* Grzybowski.
- FIG. 13. *Virgulina schreibersiana* Czjzek, var. *marginata* Heron-Allen and Earland.
- FIGS. 14 *a-c.* *Virgulina dibollensis* Cushman and Applin. *a*, side view; *b*, peripheral view; *c*, apertural view.
- FIG. 15. *Virgulina zetina* Cole.
- FIGS. 16 *a, b.* *Virgulina (Virgulinella) pertusa* Reuss. *a*, *b*, opposite sides.
- FIGS. 17 *a, b.* *Virgulina (Virgulinella) gunteri* Cushman. *a*, *b*, opposite sides.
- FIG. 18. *Virgulina (Virgulinella) gunteri* Cushman, var. *curtata* Cushman and Ponton.
- FIG. 19. *Virgulina (Virgulinella) miocenica* Cushman and Ponton.



VIRGULINA CALIFORNIENSIS Cushman (Pl. 3, figs. 8 a-c)

Virgulina californiensis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, 1925, p. 32, pl. 5, figs. 11 a-c; vol. 2, pt. 3, 1926, p. 54.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 108, pl. 12, figs. 2 a, b.

This species has very short, subglobular chambers, clearly triserial in the young, and later in the twisted biserial form with the breadth reduced toward the apertural end. The species is known only from the Miocene of California.

VIRGULINA BRAMLETTI Galloway and Morrey (Pl. 3, figs. 9 a, b)

Virgulina bramletti GALLOWAY and MORREY, Bull. Amer. Pal., vol. 15, 1929, p. 37, pl. 5, fig. 14.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 94, pl. 13, fig. 30.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 109, pl. 12, figs. 4 a, b.

Virgulina schreibersiana CUSHMAN (not CZJZEK), Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, No. 10, 1927, p. 153, pl. 3, fig. 3.

This species has nearly straight sides and rather elongate chambers, the apertural end somewhat truncate. It is related to *V. schreibersiana* Czjzek. The types are from the Miocene of Manta, Ecuador, and it is known also from the Miocene of Venezuela and California, as well as living off the West coast of America.

VIRGULINA FUSIFORMIS Cushman (Pl. 3, figs. 10 a, b)

Virgulina fusiformis CUSHMAN, Bull. 4, Fla. State Geol. Survey, 1930, p. 45, pl. 8, figs. 8 a, b.

This is a very distinct, short, fusiform species with a few inflated chambers and a small aperture. It is a fairly common species in the upper part of the Choctawhatchee marl of Florida, but is very limited in its range even in the Miocene of Florida.

SPECIES WITH TYPES FROM THE OLIGOCENE

VIRGULINA MUSTONI Andreae (Pl. 3, figs. 11 a, b)

Virgulina mustoni ANDREAE, Abhandl. Geol. Specialkarte Elsass-Lothr., vol. 2, pt. 3, 1884, p. 162, pl. 11, figs. 4 a, b.—STEUER, Notiz. Ver. geol. Landes. Darmstadt, ser. 4, vol. 25, 1904 (1905), p. 23.—BEUTLER, Neues Jahrb. für Min., pt. 2, 1909, p. 152.

The above references are all from the Oligocene of central Europe. The type figures seem to show that this is probably irregularly triserial throughout as do topotype specimens in my

own collection. It is a very tapering species with the greatest breadth toward the apertural end and showing little tendency to compression.

SPECIES WITH TYPES FROM THE EOCENE

VIRGULINA HUNGARICA Hantken

Virgulina hungarica HANTKEN, Mitth. a. d. Jahrb. k.-ungar. geol. Anstalt, vol. 1, 1871 (1872), p. 135, pl. 2, figs. 15 *a*, *b*.

The plate in the available copy of this work is missing, and a figure of it cannot be given at this time. The species is from the Eocene of Hungary.

VIRGULINA DIGITALIS Grzybowski (Pl. 3, fig. 12)

Virgulina digitalis GRZYBOWSKI, Rozpraw. Akad. umiej. Krakow, vol. 10, 1896, p. 290, pl. 9, fig. 31.

The above is the only reference for this species which is from the Red Zone of Wadowice.

VIRGULINA SCHREIBERSIANA Czjzek, var. MARGINATA Heron-Allen and Earland (Pl. 3, fig. 13)

Virgulina schreibersiana CZJZEK, var. *marginata* HERON-ALLEN and EARLAND, Bull. Geol. Survey Nigeria, Appendix, 1922, p. 142, pl. 12, figs. 4 *a*, *b*.

The only record for this very peculiar form is from the Eocene of Nigeria.

"The separate chambers are undercut or excavated at their upper edge, and furnished with minute cusps or spines at the angular upper edges of the chambers. It is probably a pauperate form, all the specimens being very thin-shelled."

VIRGULINA DIBOLLENSIS Cushman and Applin (Pl. 3, figs. 14 *a-c*)

Virgulina dibollensis CUSHMAN and APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 168, pl. 7, figs. 7 *a-c*.

This is a very slender, somewhat compressed species with at least four pairs of chambers rather regularly biserial, the very earliest ones triserial and the whole test but little twisted. The types are from the Upper Eocene of Texas, and it occurs elsewhere in the Upper Eocene of the Gulf Coastal Plain of the United States.

VIRGULINA ZETINA Cole (Pl. 3, fig. 15)

Virgulina mexicana COLE (not CUSHMAN), Bull. Amer. Pal., vol. 14, 1927, No 5, p. 25, pl. 5, fig. 14. (Corrected to *V. zetina* in errata.)

"Test small, compressed, axis slightly twisted; triserial portion very short, biserial chambers elongate, bolivine; sutures distinct, slightly depressed; wall smooth, very finely perforate; aperture comma-shaped, at the end of the last chamber. Length 0.30-0.55 mm."

This species is described from the Guayabal formation of Mexico, and also occurs in the Tempool.

MIOCENE SPECIES OF THE SUBGENUS VIRGULINELLA

VIRGULINA (VIRGULINELLA) PERTUSA Reuss (Pl. 3, figs. 16 a, b)

Virgulina pertusa REUSS, Sitz. Akad. Wiss. Wien, vol. 42, 1860, pp. 362, 368, pl. 2, figs. 16 a, b; Bull. Acad. Roy. Sci. Belg., ser. 2, vol. 15, 1863, p. 153.—HOSIUS, Ver. Nat. Hist. Vereins Pr. Rheinlande, vol. 50, 1893, p. 119.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 53, pl. 9, figs. 1-4.

Bulimina andreae SCHUBERT, Sitz. Deutsch. Nat.-med. Ver. für Böhmen "Lotos", 1900, p. 59, pl. 2, figs. 3 a, b.

The original figures are somewhat conventionalized but the 1929 reference has toptype specimens figured. It is rather regularly tapering with greatest breadth near the apertural end.

VIRGULINA (VIRGULINELLA) GUNTERI Cushman (Pl. 3, figs. 17 a, b)

Virgulina floridana CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 54, pl. 9, figs. 7-10, a (Not *V. floridana* CUSHMAN, 1920.)

Virgulina gunteri CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 105.—CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 7, 1931, pl. 4, fig. 17.

This is a compressed fusiform species, smaller and more slender than the European species. It is abundant and widely distributed in the Miocene of Florida.

VIRGULINA (VIRGULINELLA) GUNTERI Cushman, var. CURTATA Cushman and Ponton
(Pl. 3, fig. 18)

On a previous page in these Contributions we have described this very short variety which in the Florida Miocene entirely replaces the type form in the *Ecphora* Zone of the Choctawhatchee marl.

VIRGULINA (VIRGULINELLA) MIOCENICA Cushman and Ponton (Pl. 3, fig. 19)

Virgulina miocenica CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 7, 1931, p. 32, pl. 4, figs. 14-16.

This species most closely resembles the European species, but is smaller, more slender, and has more inflated chambers. It is common in the Lower Miocene of Florida and Maryland, and is apparently the ancestral form of *V. gunteri* which replaces it in the Upper Miocene.

There are other species, such as *Virgulina reussi* Geinitz from the Cretaceous which is a *Bolivina*, which are not noted here. A few other species described under other genera may also finally be brought under *Virgulina*, but a study of type material is necessary before this can be done. These include such forms as Costa's *Polymorphina longissima* and *P. innormalis*.

The outline figures in the accompanying plates are from the originals, but in the older figures particularly no magnifications are given. Therefore, the relative size of the figures given here is not representative of the relative size of the specimens themselves.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand.

Colom, Guillermo.

Las margas Rojas con Rosalinas del senoniense de Velez-Blanco (Prov. de Almeria).

(Bull. Inst. Cat. Hist. Nat., vol. XXXI, No. 1, 1931, pp. 1-8, 2 pls., 20 figs. [in text].) *Barcelona.*

Numerous sections of Cretaceous species are given.

Hofker, J.

Preliminary Note on a Statistic Statement of Trimorphism in *Biloculina sarsi* Schlumberger.

(Tijdschr. Ned. Dierkundige Vereeniging, ser. 3, vol. 2, pt. 4, 1931, pp. 179-184, 2 figs. [in text].)

Describes trimorphism in this deep sea species.

Hanzawa, S.

Notes on the Raised Coral Reefs and Their Equivalent Deposits in Taiwan (Formosa) and Adjacent Islets.

(Records Oceanographic Works in Japan, vol. III, No. 2, 1931, pp. 37-52, 10 pls., 3 figs. [in text].) *Tokyo.*
Lists ten species of foraminifera.

Colom, G.

Estudios Litologicos Sobre el Cretacico Inferior de Mallorca.
(Bol. Soc. Espanola Hist. Nat., vol. XXXI, 1931, pp. 529-545.) *Madrid.*

Figures a few Cretaceous foraminifera in section.

Gerth, H.

Der geologische Bau Javas.

(Geol. Rundschau, vol. XXII, 1931, pp. 188-200.)

Tables give the complete Tertiary section with index foraminifera of each portion.

Makiyama, Jiro.

Stratigraphy of the Kakegawa Pliocene in Totomi.

(Mem. College Sci., Kyoto Imper. Univ., ser. B, vol. VII, No. 1, (Article 1), 1931, pp. 1-53, pls. 1, 2, figs. 1-4 [in text], map.) *Kyoto.*

Lists of foraminifera are given from 6 localities; 3 species are described and figured as new.

Dunbar, Carl O. and John Skinner.

New Fusulinid Genera from the Permian of West Texas.

(Amer. Journ. Sci., vol. XXII, Sep., 1931, pp. 252-268, 3 plates.) *New Haven.*

Three new genera, *Pseudofusulina*, *Parafusulina* and *Polydiexodina*, with 4 new species are described and figured.

Hofker, J

Die Foraminiferen aus dem Senon Limburgens. XII. *Cymbalopora radiata* Hagenow.

(Nat. Hist. Maandblad, Jaarg. 20, No. 9, Sep. 30, 1931, pp. 125-130, figs. 1-7 [in text].) *Limburg.*

Later evidence seems to prove this species a foraminiferal one.

Thomas, Norman L.

New Early Fusulinids from Texas.

(Univ. Texas Bull. 3101, Oct., 1931, pp. 27-33, pl. 1.)

Austin.

Two species described and figured, 1 new.

Liebus, Adalbert.

Die Fossilen Foraminiferen eine Einführung in die Kenntnis Ihrer Gattungen.

(Knihovna Statního Geologického Ústavu Československé Republiky Svazek 14B, 1931, 159 pp., 349 figs. [in text].)

Prague.

Gives introductory chapters on general subjects followed by descriptions and figures of the genera found fossil.

Lacroix, E.

Microtexture du test des Textularidae.

(Bull. Institut. Oceanographique, No. 582, Oct. 1, 1931, pp. 1-18, 11 figs. [in text].)

Monaco.

Gives results of studies of the wall structure of numerous species with illustrations. Three new species are described.

Plummer, Helen Jeanne.

Some Cretaceous Foraminifera in Texas.

(Univ. Texas Bull. 3101, Oct., 1931, pp. 109-203, pls. 8-15.)

Austin.

An excellently illustrated paper with a new genus, *Dorothia*, and 13 new species.

Barbat, W. F. and A. Allen Weymouth.

Stratigraphy of the Borophagus littoralis Locality, California.

(Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 21, No. 3, 1931, pp. 25-36, pls. 4, 5; 2 figs. [in text].)

Berkeley.

Gives records of several foraminiferal genera and species in the section.

Scheffen, W.

De Fylogenetische Beteekenis der Bestanddeelen van het Foraminiferen skelet.

(De Mijningenieur, No. 11, Nov., 1931, pp. 206-208, 7 figs. [in text].)

Bandoeng.

Gives interesting notes on structure of orbitoids.

Sayles, Robert W.

Bermuda During the Ice Age.

(Proc. Amer. Acad. Arts Sci., vol. 66, No. 11, Nov., 1931, pp. 381-467, pls. 1-13, 18 figs. [in text].)

Boston.

Lists of foraminifera from the fossil soils and eolianite are given, pp. 437-439.

Cushman, Joseph A. and Frances L. Parker.

Recent Foraminifera from the Atlantic Coast of South America.

(Proc. U. S. Nat. Mus., vol. 80, Art. 3, 1931, pp. 1-24, pls. 1-4.) *Washington.*

Collections from Rio de Janeiro to the Falklands are described and figured with 3 new species and varieties.

Rutten, L. M. R.

Feestbundel K. Martin. Deel II. De Palaeontologie en Geologie van Nederlandsch West-Indië. Hoofdstuk I. De Palaeontologie van Nederlandsch West-Indië. 21. Our Palaeontological Knowledge of the Netherlands West-Indies in 1930.

(Leidsche Geologische Mededeelingen, Deel V, Nov. 24, 1931, pp. 651-668.) *Leiden.*

Gives catalogue of foraminifera among other groups.

Galloway, J. J. and Margaret Morrey.

Late Cretaceous Foraminifera from Tobasco, Mexico.

(Journ. Pal., vol. 5, No. 4, Dec., 1931, pp. 329-354, pls. 37-40.) *Menesha.*

Record and figure a fauna of 56 species with 11 given as new.

Henbest, Lloyd G.

The Use of Selective Stains in Paleontology.

(Journ. Pal., vol. 5, No. 4, Dec., 1931, pp. 355-364.)

Menesha.

The methods given are especially applicable to the fossil foraminifera.

Thomas, Norman L. and Elmer M. Rice.

Notes on the Saratoga Chalk.

(Journ. Pal., vol. 5, No. 4, Dec., 1931, pp. 316-328.)

Menesha.

Record the vertical distribution of numerous species of foraminifera of this formation.

Cushman, Joseph A.

The Foraminifera of the Saratoga Chalk.

(Journ. Pal., vol. 5, No. 4, Dec., 1931, pp. 297-315, pls. 34-36.) *Menesha.*

Records and figures the species of this Cretaceous chalk with 1 species new.

Leupold, W. and I. M. van der Vlerk.

Feestbundel K. Martin. Deel I. De Palaeontologie en Stratigraphie van Nederlandsch Oost-Indië. Hoofdstuk III. De Stratigraphie van Nederlandsch Oost-Indië. 20. Tertiary.

(Leidsche Geologische Mededeelingen, Deel V, 1931, pp. 611-648, 2 tables.) *Leiden.*

Gives detailed distribution of foraminifera of this region with charts of vertical ranges.

Umbgrove, J. H. F.

Feestbundel K. Martin. Deel I. De Palaeontologie en Stratigraphie van Nederlandsch Oost-Indië. Hoofdstuk I. Onze Palaeontologische Kennis van Nederlandsch Oost-Indië in 1930. 2. Tertiary Foraminifera.

(Leidsche Geologische Mededeelingen, Deel V, Nov. 24, 1931, pp. 35-91.) *Leiden.*

Gives detailed bibliography of East Indian species.

Cushman, Joseph A.

A Preliminary Report on the Foraminifera of Tennessee.

(Bull. 41, Division of Geology, Tennessee, 1931, pp. 1-116, pls. 1-13.) *Nashville.*

Describes and figures 101 species and varieties from the Cretaceous, with 13 new.

J. A. C.

